

***Ophiotaenia alessandrae* sp. n. (Eucestoda: Proteocephalidea), a parasite of *Hyla boans* (Anura: Hylidae) from Amazonia in Ecuador**

Claudia M. V. MARSELLA^{1,2} & Alain de CHAMBRIER¹

¹ Muséum d'histoire naturelle, P.O. Box 6434, CH-1211 Geneva 6, Switzerland.

E-mail: alain.dechambrier@ville-ge.ch

² Université de Genève, Faculté des Sciences, Département de Zoologie et Biologie animale, 30, quai Ernest-Ansermet, CH-1211 Genève 4

***Ophiotaenia alessandrae* sp. n. (Eucestoda: Proteocephalidea), a parasite of *Hyla boans* (Anura: Hylidae) from Amazonia in Ecuador.** - *Ophiotaenia alessandrae* sp. n., is described from the intestine of the hylid frog, *Hyla boans* (Linnaeus, 1758) (Anura: Hylidae), from Amazonia in Ecuador. The new species differs from the 24 known species of the genus *Ophiotaenia* La Rue, 1911, parasitic in amphibians by the presence of an additional layer egg envelope forming a three layers embryophore. Furthermore, it differs from these species by one to several other morphological characters such as absence of apical organ, anterior and posterior position of the vagina, number of testes and the cirrus-sac length/proglottis width ratio. The presence of two kinds of secondary canals in proteocephalideans is discussed. This is the first observation of a three-layered embryophore in New World amphibians.

Keywords: Taxonomy - morphology - Amphibia - South America.

INTRODUCTION

A proteocephalidean tapeworm belonging to *Ophiotaenia* La Rue, 1911, was found in a hylid frog *Hyla boans*, during a survey of amphibians and reptiles parasites in Ecuador between 1983 and 1990 conducted by Jean-Marc Touzet. Since this cestode differs from all 24 species of the genus described from amphibians in the world, it is described a new taxon herein.

MATERIALS AND METHODS

Nine specimens of *Hyla boans* (Linnaeus, 1758) from San Pablo de Kantesiya, and Hacienda Primavera, Napo Province; and from Zapallo Grande, Rio Cayapa, Esmeraldas Province, Ecuador, were examined. They were killed by immersion in a 1% MS 222 solution (Methanesulfonate salt, Sigma, No A-5040) and immediately dissected. The digestive tract was fixed with hot 4% neutral formalin and subsequently stored in 75% ethanol. Strobila was stained with Mayer's hydrochloric carmine, dehydrated in a grades series of ethanol, cleared in eugenol (clove oil), and mounted as permanent preparations in Canada balsam. For histology, pieces of strobila were

embedded in paraffin wax, transversely sectioned at 12-15 μm intervals, stained with Weigert's hematoxylin and counterstained with 1% eosin B (see de Chambrier, 2001). Eggs were studied in distilled water. The specimen has been deposited in the helminthological collection of the Natural History Museum, Geneva, Switzerland (INVE). All measurements are given in micrometers unless otherwise indicated. Abbreviations used in descriptions are as follows: $\bar{x}$ = mean; n = number of measurements; CV = coefficient of variation.

RESULTS

Ophiotaenia alessandrae sp. n.

Figs 1-10

TYPE MATERIAL: Holotype MHNG INVE 22093, 3 whole mounted slides, 5 transverse sections series slides.

TYPE LOCALITY: Hacienda Primavera, Río Napo, Napo Province, Ecuador, 22.07.1987. 0°26'S, 76°46'W; Field number Ec 3590, Jean-Marc Touzet leg.

DESCRIPTION (BASED ON ONE ENTIRE SPECIMEN): Proteocephalidae, Proteocephalinae. Large-sized worm, 138 mm long, up to 1.6 mm wide, flattened dorsoventrally, with last proglottides elongated. Strobila acraspedote, anapolytic. About 62-65 immature proglottides (up to appearance of spermatozoa in vas deferens), 9 mature proglottides (up to appearance of eggs in uterus), 10 pregravid proglottides (up to appearance of hooks in oncospheres); about 134 proglottides in total. Proliferation zone posterior to scolex short, 450 long. Immature, mature, pregravid proglottides wider than long; and gravid proglottides longer than wide. Last gravid proglottides elongated (length: wide ratio 2.3: 1).

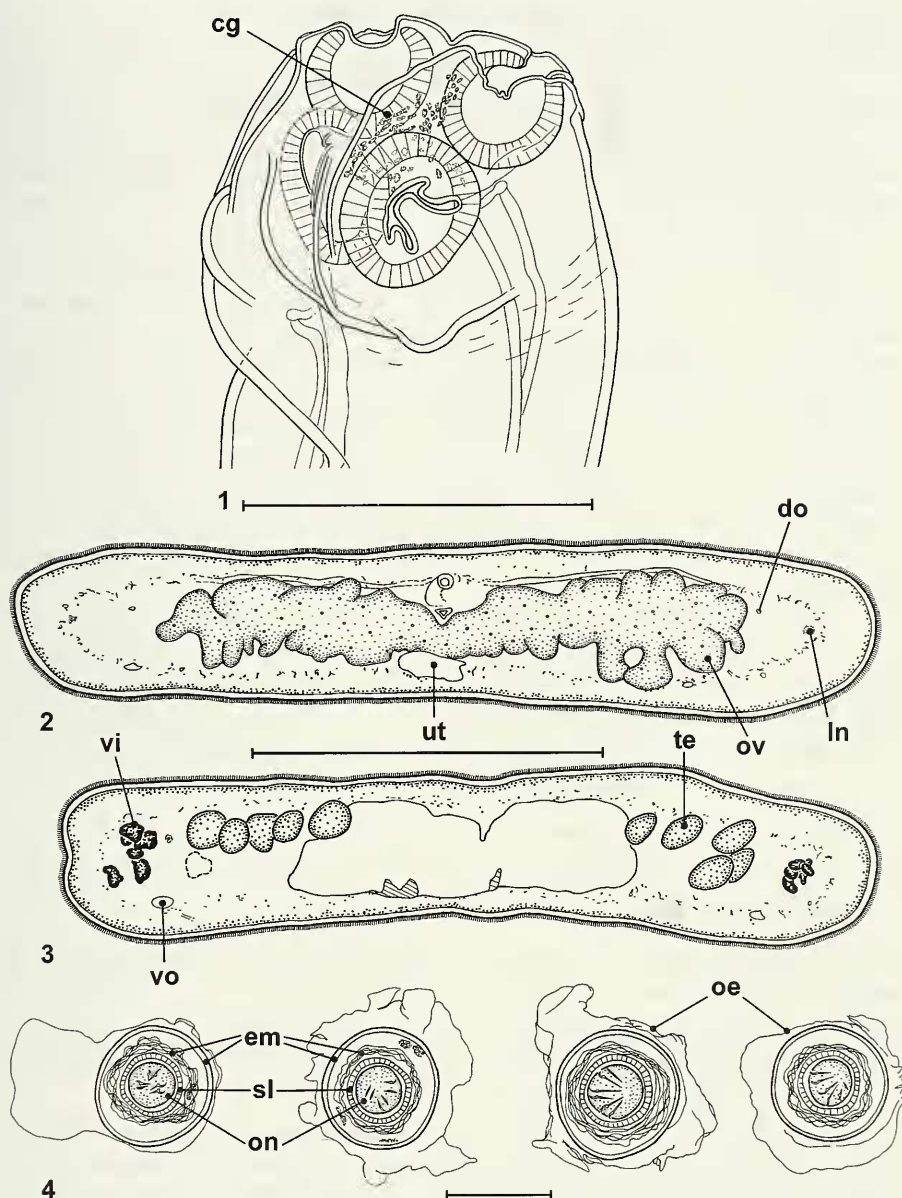
Scolex round, containing numerous cells with granular inclusions (Fig. 1). Scolex 475 in diameter (Fig. 1). Four small uniloculate suckers, 185-215 in diameter. Apical organ absent.

Internal longitudinal musculature weakly developed (Figs 2, 3), forming small anastomosed bundles of muscular fibres. Osmoregulatory canals usually situated between vitellaria and testes. Ventral canal often overlapping vitellaria (Figs 5, 6), more rarely testes, sometimes in cortex (Fig. 3). Ventral canals anastomosed, (sometimes forming a lengthy tube stretching parallel to the ventral canal itself) 20-35 in diameter, with numerous secondary canals, ending beneath the tegument; dorsal canals 3-7 in diameter (Figs 5-7).

Testes medullary, spherical to oval, 55-80 in diameter, numbering 86-128 ($\bar{x}$ = 111, n = 18, CV = 11), in one or two layers, in two lateral fields between anterior margin and preovarian space, never reaching to ovary (Figs 5-6), degenerated in last gravid proglottides. Vas deferens coiled, very thin-walled, not reaching to midline of proglottis (Figs 5-7). Cirrus-sac elongate, thick-walled in its distal part, 180-235 long, representing 11-17% ($\bar{x}$ = 15%, n = 18, CV = 10%) of proglottis width. Cirrus occupying up to 75% of cirrus-sac length (Fig. 7).

Genital ducts passing between osmoregulatory canals. Genital atrium present. Genital pores irregularly alternating, situated at 35-53% ($\bar{x}$ = 43%, n = 18, CV = 13%) of proglottis length.

Vagina posterior (in 55% of the proglottides) or anterior (in 45% of the proglottides, n = 20) to cirrus-sac, in proximal part lined with intensely staining cells.



FIGS 1-4

Ophiotaenia alessandrae sp. n. Holotype, from *Hyla boans*, Ecuador (MHNG INVE 22093). (1) Scolex, dorsoventral view. (2) Cross section at level of ovary. (3) Cross section at level of uterus. (4) Eggs drawn in distilled water; note the supplementary layer. (7) Terminal genitalia, ventral view. Abbreviations: cg = glandular cells; do = dorsal osmoregulatory canal; em = embryophore; lm = internal longitudinal musculature; ln = longitudinal lateral nerves; oe = outer envelope; on = oncosphere; ov = ovary; sl = supplementary layer; te = testes; ut = uterus; vi = vitellaria; vo = ventral osmoregulatory canal. Scale bars: 1-3 = 500 μ m; 4 = 20 μ m.

Discrete muscular terminal sphincter present (Figs 6-7). Mehlis' glands 80-105 in diameter, 7-8% of proglottis width.

Ovary medullary, bilobed, small, folliculate ventrally, 830-1150 wide, occupying 66-77% ($x = 70\%$, $n = 19$, $CV = 4\%$) of proglottis width (Figs 2, 5, 6).

Vitelline follicles medullary, oval to elongate, small, in two lateral fields, interrupted porally by vagina and cirrus-sac, not reaching to anterior and posterior margins of proglottides, occupying porally 81-90 % and aporally 74-92 % of proglottis length, respectively (Figs 5-7).

Anlage of uterus medullary, already present in immature proglottides. Uterus with 18-25 ($n = 13$) latero-dorsal diverticula on each side (Figs 5-6). Formation of uterus of type 1 according to de Chambrier et al. (2004a): uterine stem with tubular concentration of numerous intensely staining cells and with lumen in last immature and first mature proglottides (Fig. 5). In mature proglottides, thin-walled lateral diverticula appear, with distal part lined with some intensely staining cells. At this stage, uterus occupying up to 11% of proglottis width. In pregravid proglottides, eggs completely filling uterine stem and diverticula, that occupy up to 42% of proglottis width (Fig. 6). In gravid proglottides, thin-walled digitate diverticula growing laterally, occupying up to 83% of proglottis width, opening ventrally by several longitudinal apertures in gravid proglottides.

Eggs spherical, with thin, hyaline outer envelope, up to 50 in diameter; inner envelope consisting in two-layered embryophore, with external thick layer, 22-24 in diameter and nucleate irregular envelope, 17-20 in diameter; thick additional spherical layer, 12-13 in diameter between embryophore and oncosphere; oncospheres 9-10 in diameter, with 3 pairs of embryonic hooks, 5-6 long ($n = 7$) (Figs 4, 10).

TYPE-HOST: *Hyla boans* (Linnaeus, 1758) (Hylidae).

SITE OF INFECTION: Intestine.

PREVALENCE: 1/9 (11%).

INTENSITY: 1 specimen.

ETYMOLOGY: The new species is named in honour of Alessandra Marsella, mother of the first author.

DIFFERENTIAL DIAGNOSIS: The new species belongs to the genus *Ophiotaenia* because of the medullary position of gonads, the presence of four simple unilocular suckers and two testes fields (Freze, 1965; Schmidt, 1986).

Out of approximately 75 currently recognized species of *Ophiotaenia* parasitizing reptiles and amphibians, 24 species are found in amphibians (Fuhrmann, 1895; La Rue, 1909; 1914a, b; Hungenbühler, 1910; Johnston, 1912; Parodi and Widakowich, 1916; Hannum, 1925; Woodland, 1925; Osler, 1931; Zelif, 1932; Ingles, 1936; Yamaguti, 1938; Riser, 1942; Wolffhügel, 1948; Szidat and Soria, 1954; Flores-Barroeta, 1955; Jones *et al.*, 1958; Dyer and Altig, 1977; Gupta and Arora, 1979; Sharpilo *et al.*, 1979; Srivastav and Capoor, 1980; Dyer, 1986; de Chambrier, 2004; Puga and Formas, 2005; de Chambrier *et al.*, 2006) (Table 1).

Ophiotaenia alessandrae n. sp. differs from all *Ophiotaenia* species, parasites of amphibians, in the possession of a third layer in the eggs embryophore (Fig. 4, 10).

TABLE 1. *Ophiotaenia* species in amphibian hosts.

Species	Host	Locality
<i>Ophiotaenia alternans</i> Riser, 1942	<i>Amphiuma tridactylum</i>	U.S.A.
<i>O. amphiumae</i> (Zeliff, 1932)	<i>Amphiuma tridactylum</i>	U.S.A.
<i>O. bonariensis</i> Szidat & Soria, 1954	<i>Leptodactylus ocellatus</i>	Argentina
<i>O. bonneti</i> de Chambrier, Coquille & Brooks, 2006	<i>Rana vaillanti</i>	Costa Rica
<i>O. bufonis</i> Vigueras, 1942	<i>Bufo peltacephalus</i>	Cuba
<i>O. calamensis</i> Pugas & Formas, 2005	<i>Telmatobius dankoi</i>	Chile
<i>O. carpathica</i> (Sharpilo, Korniyushin et Lisitsina, 1979)	<i>Triturus cristatus</i>	Ukraine
<i>O. ceratophrys</i> (Parodi et Widakowich, 1916)	<i>Ceratophrys ornata</i>	Argentina
<i>O. cryptobranchi</i> La Rue, 1914	<i>Cryptobranchus alleganiensis</i>	U.S.A.
<i>O. ecuadorensis</i> Dyer, 1986	<i>Hyla geographica</i>	Ecuador
<i>O. filaroides</i> (La Rue, 1909)	<i>Amblystoma tigrinum</i>	U.S.A.
<i>O. gracilis</i> Jones, Cheng et Gillespie, 1958	<i>Rana catesbeiana</i>	U.S.A.
<i>O. hernandezi</i> (Flores-Barroeta, 1955)	<i>Rana</i> sp.	Mexico
<i>O. junglensis</i> (Srivastav et Capoor, 1980)	<i>Hoplobatrachus tigerinus</i>	India
<i>O. hylae</i> Johnston, 1912	<i>Litoria aurea</i>	Australia
<i>O. loennbergii</i> (Fuhrmann, 1895)	<i>Necturus maculosus</i>	U.S.A.
<i>O. magna</i> Hannum, 1925	<i>Rana catesbeiana</i>	U.S.A.
<i>O. noei</i> Wolffhügel, 1948	<i>Caudiverbera caudiverbera</i>	Chile
<i>O. olor</i> (Ingles, 1936)	<i>Rana aurora</i>	U.S.A.
<i>O. olseni</i> Dyer et Altig, 1977	<i>Hyla geographica</i>	Ecuador
<i>O. ranae</i> Yamaguti, 1938	<i>Rana nigromaculata</i>	Japan
<i>O. saphena</i> Osler, 1931	<i>Rana clamitans</i>	U.S.A.
<i>O. schultzei</i> (Hungerbühler, 1910)	<i>Pyxicephalus adspersus</i>	South Africa
<i>O. tigrina</i> (Woodland, 1925)	<i>Hoplobatrachus tigerinus</i>	India

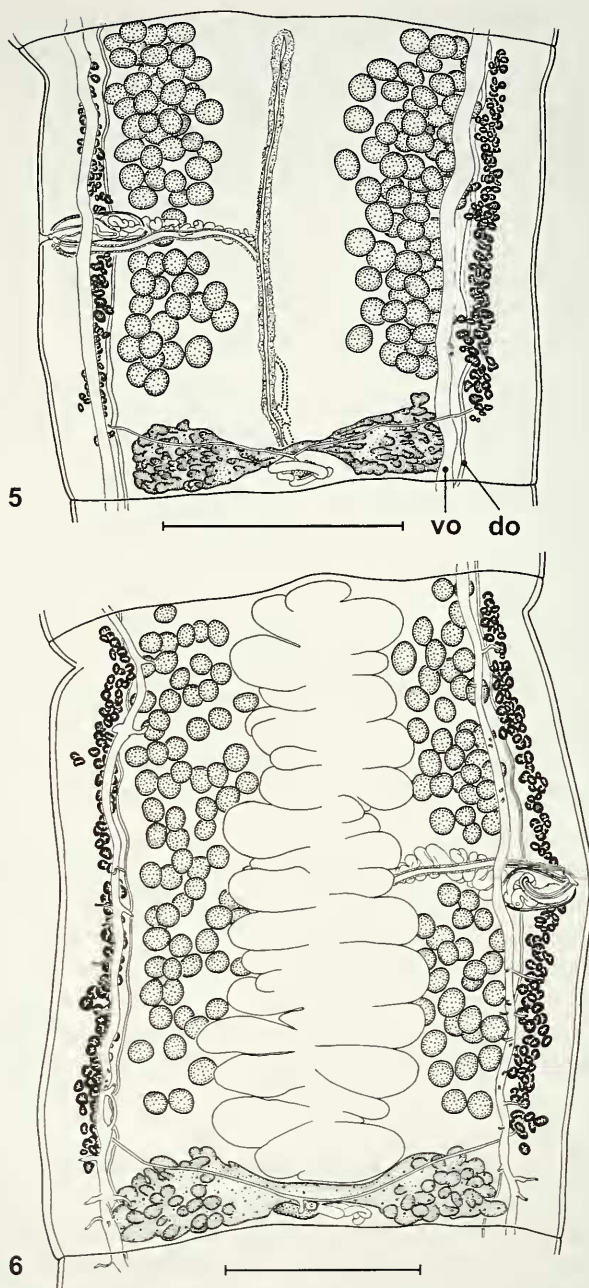
It can also be distinguished from the majority of these *Ophiotaenia* species by one or more of the following characters: anterior and posterior position of vagina (in relation to cirrus-sac); absence of apical organ; number of testes; cirrus-sac length/proglottis width ratio; and position of the genital pore.

O. ceratophrys and *O. loennbergi* are most similar to *O. alessandrae*, but they can nevertheless be unambiguously distinguished from the new species: *O. ceratophrys* shows a bigger scolex (700 in diameter), testes in one field, and is larger (380 mm); while *O. loennbergi* presents a higher number of uterine diverticles (25-40).

DISCUSSION

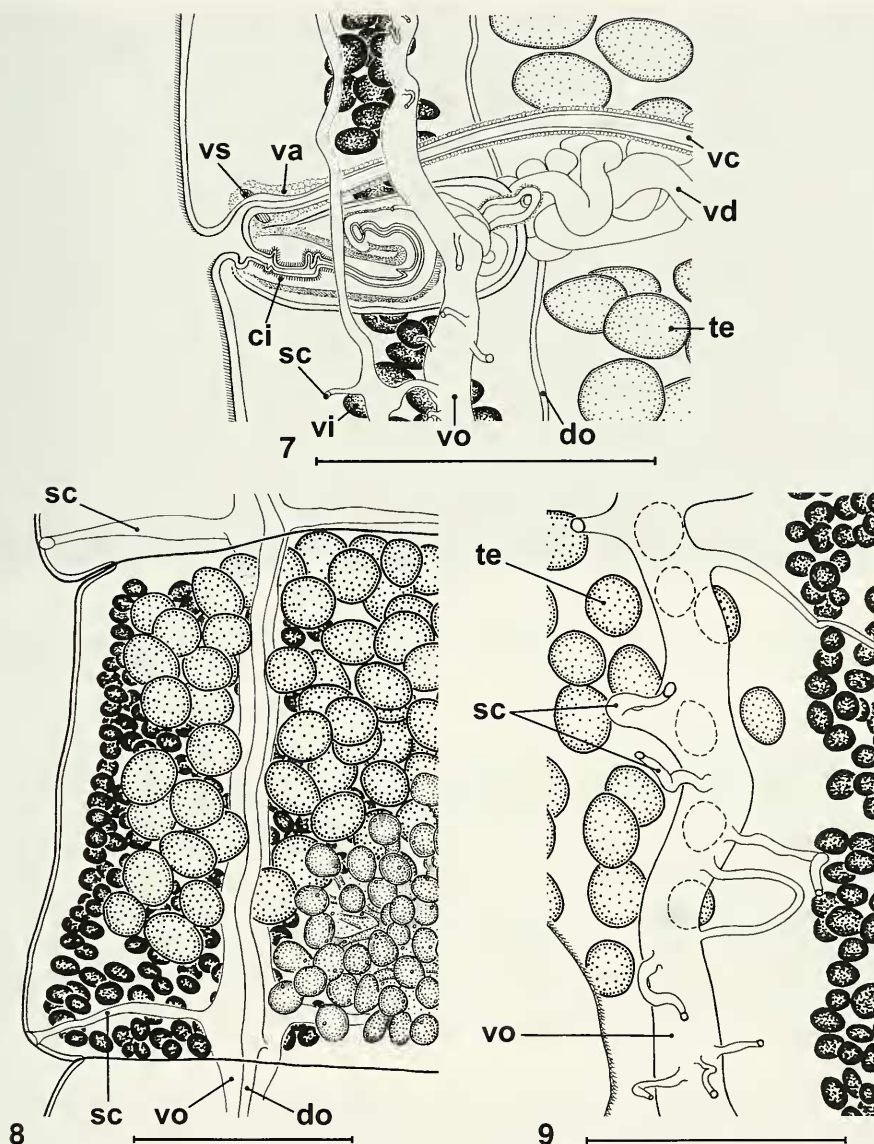
We observed an additional layer of the embryophore in the eggs of *O. alessandrae*. This third layer is situated between the oncosphere and the bilayered embryophore, and so represents, in our opinion, a three-layered embryophore. This structure was first observed in some eggs of proteocephalideans parasitizing reptiles from Indonesia (*Kapsulotaenia sandgroundi*) and Australia (*Ophiotaenia* spp, see de Chambrier, 2006).

This is the first observation of this feature within an *Ophiotaenia* species in South American amphibian host. The only other South American proteocephalidean possessing similar embryophore is *Proteocephalus hobergi* de Chambrier & Vaucher,



FIGS 5-6

Ophiotaenia alessandrae sp. n. Holotype, from *Hyla boans*, Ecuador (MHNG INVE 22093). (5) Mature proglottis, ventral view. (6) Gravid proglottis, ventral view; note the presence of secondary canals of the ventral osmoregulatory canals. Abbreviations: do = dorsal osmoregulatory canal; vo = ventral osmoregulatory canal. Scale bars: 5-6 = 500 μ m.



FIGS 7-9

(7) *Ophiotaenia alessandrae* sp. n. Holotype, from *Hyla boans*, Ecuador (MHNG INVE 22093), terminal genitalia, ventral view. (8) *Brooksiella praeputialis* (Rego, Santos & Silva, 1974), detail of a mature proglottis, dorsal view, showing the secondary canals situated posteriorly and ending laterally beneath the tegument. (9) *Thaumasiocolex didelphidis* Cañeda-Guzman, de Chambrier & Scholz, 2001, detail of ventral osmoregulatory canal with numerous secondary canals directed to the ventral surface. Abbreviations: ci = cirrus; do = dorsal osmoregulatory canal; lm = internal longitudinal musculature; sc = secondary canal; te = testes; va = vagina; vc = vaginal canal; vd = vas deferens; vi = vitellaria; vo = ventral osmoregulatory canal; vs = vaginal sphincter. Scale bars: 7-9 = 250 μ m.

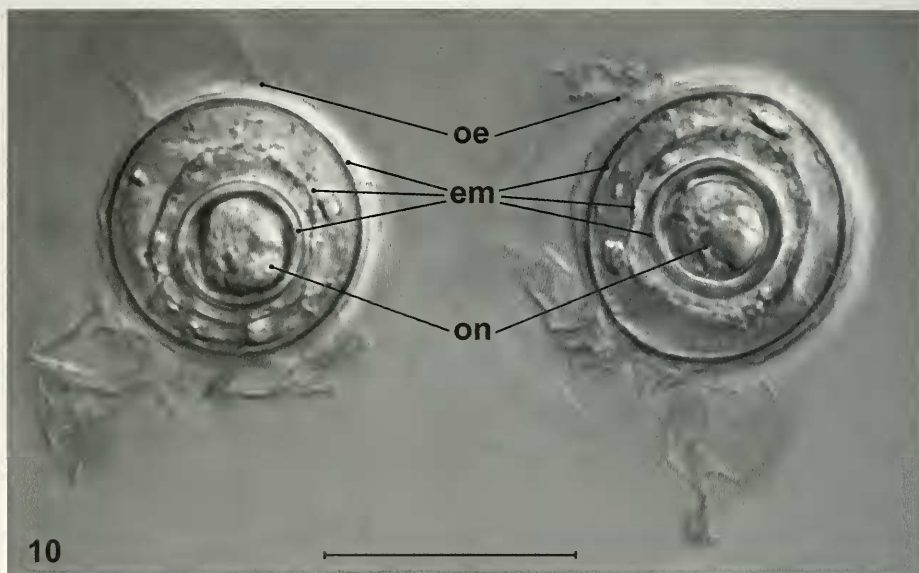


FIG. 10

Eggs in distilled water, captured with Nikon Eclipse 80i, showing the three-layered embryophore. Abbreviations: em = embryophore; oe = outer envelope; on = oncospheres. Scale-bar: 20 μ m.

1999 (parasite in fish) (see de Chambrier & Vaucher 1999, Fig. 8). But, the third layer in *P. hobergi* is lime-shaped. Furthermore, those eggs are very peculiar in shape, size and development. The *P. hobergi* embryophores diameter (80-93 x 40-44) is twice to three times the size of that encountered in most proteocephalidean, which usually reach not more than 30 in diameter.

The presence of secondary osmoregulatory canals is a known feature of Proteocephalidea, where two kinds of such structures have been described: the first one is always situated in the posterior part of the proglottis at the level of the ovary and ending at the tegument surface (Fig. 8); the second one is distributed irregularly all along the ventral osmoregulatory canals (Fig. 9). Both are connected with the ventral surface.

The first kind of a secondary canal was that described by Riggenbach (1896, Fig. 41) in *Corallobothrium lobosum* Riggenbach, 1896 (= *Rudolphiella lobosa*). Later, numerous species were signalled possessing this feature in several subfamilies, such as Gangesiinae (*Gangesia parasiluri* Yamaguti, 1934, Fig. 15 in de Chambrier *et al.*, 2003), Proteocephalinae (*Proteocephalus vladimirae* de Chambrier & Vaucher, 1999, Fig. 17), Peltidocotylinae (*Mariauxiella pimelodi* de Chambrier & Rego, 1995, Fig. 3, *Amazotaenia yvetteae* de Chambrier, 2003, Figs. 2, 6), Endorchiinae (*Endorchis auchenipteri* de Chambrier & Vaucher, 1999, Fig. 61), Monticelliinae (*Monticellia ventrei* de Chambrier & Vaucher, 1999, Fig. 46), Zygobothriinae (*Brooksiella praeputialis* (Rego, Santos & Silva, 1974) (see de Chambrier *et al.*, 2004b), Rudolphiellinae, (*Rudolphiella szidati* Gil de Pertierra & de Chambrier, 2000, Fig. 1) (Rego, Santos &

Silva 1974; de Chambrier & Rego, 1995; de Chambrier & Vaucher, 1999; Gil de Pertierra & de Chambrier, 2000; de Chambrier, 2003; de Chambrier *et al.*, 2003).

The second kind, with numerous secondary canals all along the ventral osmoregulatory canals, was observed in several species of the Proteocephalinae (i.e. *Proteocephalus renaudi* de Chambrier & Vaucher, 1994, Fig. 2; *Thaumasioscolex didelphidis* Cañeda-Guzman, de Chambrier & Scholz, 2001, but also in several sub-families such as Zygobothriinae (*Nomimoscolex matogrossensis* Rego & Pavanelli, 1990, in de Chambrier *et al.*, 1996, Fig. 10; Figs. 12, 14-16), Acanthotaeniinae (*Kapsulotaenia sandgroundi* (Carter, 1943), de Chambrier, 2006, Fig. 14), Corallobothriinae (*Corallobotrium solidum* Fritsch, 1886 in Janicki, 1928, Fig. 25), (Janicki, 1928; de Chambrier & Vaucher, 1994; de Chambrier *et al.*, 1996; Cañeda-Guzman *et al.*, 2001; de Chambrier, 2006).

The prevalence of the Proteocephalidea is known to be very low in amphibians, as detailed by de Chambrier *et al.* (2006, p. 130), and such is the case for the new species described here. A single specimen was found out of nine dissected *Hyla boans*, which represent a prevalence of 11%.

When we compare the number of the amphibians species infected with Proteocephalidean with the total number of amphibian species examined, we observed that in Ecuador, only 5 hosts species out of 91 were infected (5,5%), in Paraguay, 5 out of 64 species were infected (7,8%), in Costa Rica, 1 out of 47 hosts species was infected (2%).

ACKNOWLEDGEMENTS

The authors are indebted to Jean-Marc Touzet (Lyon, France), who collected the material in Ecuador, to Jean Mariaux for fruitful comments on the early version of the manuscript, and to Tomáš Scholz for helpful discussions. We are grateful to Janik Pralong, Florence Marteau and Gilles Roth (all Geneva) for their help with laboratory assistance, page make-up and help with drawings. We thank Fernando Escobar S., Director Nacional Forestal, and Fausto Sarmiento, Director Museo Ecuatoriano de Ciencias Naturales (both in Quito) for the authorizations of the host collection. This study was supported in part by the National Science Foundation PBI award Nos. 0818696 and 0818823.

REFERENCES

- CANEDA-GUZZMANN, I. C., DE CHAMBRIER, A. & SCHOLZ, T. 2001. *Thaumasioscolex didelphidis* n. gen. and n. sp. (Eucestoda: Proteocephalidae) from the black-eared opossum *Didelphis marsupialis* from Mexico, the first proteocephalidean tapeworm from a mammal. *Journal of Parasitology* 87: 639-647.
- DE CHAMBRIER, A. 2001. A new tapeworm from the Amazon, *Amazotaenia yvettae* n. gen., n. sp., (Eucestoda: Proteocephalidea) from the siluriform fishes *Brachyplatystoma filamentosum* and *B. vaillanti* (Pimelodidae). *Revue suisse de Zoologie* 108 (2): 303-316.
- DE CHAMBRIER, A. 2003. Redescription of *Manaosia braçodemoca* Woodland, 1935 and *Paramonticellia itaipuensis* Pavanelli & Rego, 1991 (Eucestoda, Proteocephalidea) parasites of *Sorubim lima* (Siluriforme, Pimelodidae). *Folia Parasitologica* 50: 121-127.
- DE CHAMBRIER, A. 2004. Redescription of *Ophiotaenia hylae* Johnston, 1912 (Eucestoda: Proteocephalidea), parasite of *Litoria aurea* (Amphibia: Hylidae) from Australia. *Revue suisse de Zoologie* 111(2): 371-380.

- DE CHAMBRIER, A. 2006. Redescription of *Kapsulotaenia sandgroundi* (Carter, 1943), a parasite of *Varanus komodoensis* (Varanoidea: Varanidae) from Komodo Island, Indonesia. *Systematic Parasitology* 63(2): 83-93.
- DE CHAMBRIER, A. & REGO, A. A. 1995. *Mariauxiella pimelodi* n. g., n. sp. (Cestoda: Monticelliidae): a parasite of pimelodid siluroid fishes from South America. *Systematic Parasitology* 30: 57-65.
- DE CHAMBRIER, A., SCHOLZ, T. & VAUCHER, C. 1996. Tapeworms (Cestoda: Proteocephalidae) of *Hoplias malabaricus* (Pisces: Characiformes, Erythrinidae) in Paraguay: description of *Proteocephalus regoi* n. sp. and redescription of *Nomimoscolex matogrossensis*. *Folia Parasitologica* 43: 133-140.
- DE CHAMBRIER, A. & VAUCHER, C. 1994. Etude morpho-anatomique et génétique de deux nouveaux *Proteocephalus* (Cestoda: Proteocephalidae) parasites de *Platydoras costatus* (L.), poisson siluriforme du Paraguay. *Systematic Parasitology* 27: 173-185.
- DE CHAMBRIER, A. & VAUCHER, C. 1999. Proteocephalidae et Monticelliidae (Eucestoda: Proteocephalidae) parasites de poissons d'eau douce du Paraguay avec descriptions d'un genre nouveau et de dix espèces nouvelles. *Revue suisse de Zoologie* 106(1): 165-240.
- DE CHAMBRIER, A., AL KALLAK, S. N. H. & MARIAUX, J. 2003. A new Tapeworm *Postgangesia inarmata* sp. n. (Eucestoda : Proteocephalidae : Gangesiinae), parasite of *Silurus glanis* (Siluriformes) from Iraq and some considerations on Gangesiinae. *Systematic Parasitology* 55: 199-209.
- DE CHAMBRIER, A., ZEHNDER, M. P., VAUCHER, C. & MARIAUX, J. 2004 a. The evolution of the Proteocephalidae (Platyhelminthes, Eucestoda) based on an enlarged molecular phylogeny, with comments on their uterine development. *Systematic Parasitology* 57: 159-171.
- DE CHAMBRIER, A., REGO, A. A. & MARIAUX, J. 2004 b. Redescription of *Brooksiella praeputialis* and *Goezeella siluri* (Eucestoda: Proteocephalidae), parasites of *Cetopsis coecutiens* (Siluriformes) from the Amazon and proposition of *Goezeella danbrooksi* sp. n. *Revue suisse de Zoologie* 111 (1): 111-120.
- DE CHAMBRIER, A., COQUILLE, S. & BROOKS, D. R. 2006. *Ophiotaenia bonneti* n. sp. (Eucestoda: Proteocephalidae), a parasite of *Rana vaillanti* (Anura: Ranidae) in Costa Rica. *Folia Parasitologica* 53: 125-133.
- DYER, W. G. 1986. *Ophiotaenia ecuadorensis* n. sp. (Cestoda: Proteocephalidae) from *Hyla geographica* Spix, 1824 in Ecuador. *Journal of Parasitology* 72: 599-601.
- DYER, W. G. AND ALTIG, R. 1977. *Ophiotaenia olseni* sp. n. (Cestoda: Proteocephalidae) from *Hyla geographica* Spix 1824 in Ecuador. *Journal of Parasitology* 63: 790-792.
- FLORES-BARROETA, L. 1955. Cestodos de vertebrados. III. *Proteocephalus hernandezii* nov. sp., *Ophiotaenia nattereri* Parona, 1901, *Bertiella lopez-neyrai* nov. sp. *Ciencia* 15: 33-38.
- FREZE, V. I. 1965. Essentials of cestodology. Vol. V. Proteocephalata in Fish, Amphibians and Reptiles. Moskva: Isdatel'stvo "Nauka" 538 pp. (Israel Program of Scientific Translation, 1969), Cat. No. 1853. v + 597 pp.
- FUHRMANN, O. 1895. Die Tänien der Amphibien. *Zoologische Jahrbücher. Abteilung für Anatomie und Ontogenie der Tiere*, Jena 9: 207-226.
- GIL DE PERTIERRA, A. A. & DE CHAMBRIER, A. 2000. *Rudolphiella szidati* n. sp. (Proteocephalidae: Monticelliidae, Rudolphiellinae) parasite of *Luciopimelodus pati* (Valenciennes, 1840) (Pisces: Pimelodidae) from Argentina and new informations on *Rudolphiella lobosa* (Riggenbach, 1895). *Revue suisse de Zoologie* 107 (1): 81-95.
- GUPTA, N. K. AND ARORA, S. 1979. On *Proteocephalus tigrinus* Woodland, 1925 (Proteocephaloidea: Proteocephalidae), a cestode parasite of *Rana tigrina* at Amritsar (Punjab, India). *Research Bulletin (Science) of the Panjab University* 30: 27-36.
- HANNUM, C. A. 1925. A New Species of Cestode, *Ophiotaenia magna* n. sp. from the Frog. *Transactions of the American Microscopical Society* 64: 148-152.
- HUNGENBUHLER, M. 1910. Studien an Gyrocotyle und Cestoden. Ergebnisse einer von L. Schultze ausgeführten zoologischen Forschungsreise in Südafrika. Inaugural-

Dissertation zur Erlangung der Doktorwürde der hohen philosophischen Fakultät der Universität Basel, 25 pp.

- INGLES, L. G. 1936. Worm parasites of California Amphibians. *Transactions of the American Microscopical Society* 55: 73-92.
- JANICKI, C. 1928. Cestodes s. str. Aus Fischen und Amphibien. In: *Results of the Swedish zoological expedition to Egypt and the White Nile 1901*, part. 5, pp. 1-58.
- JOHNSTON, T. H. 1912. Notes on some Entozoa. *Proceedings of the Royal Society of Queensland* 24: 63-91.
- JONES, R. W., CHENG, T. C. & GILLESPIE, R. F. 1958. *Ophiotaenia gracilis* n. sp., a proteocephalid cestode from a frog. *Journal of the Tennessee Academy of Science* 33(1): 84-88.
- LA RUE, G. R. 1909. On the morphology and development of a new cestode of the genus *Proteocephalus* Weinland. *Transactions of the American Microscopical Society* 28: 17-49.
- LA RUE, G. R. 1914a. A revision of the cestode family Proteocephalidae. *Illinois Biological Monographs*, 1: 3-351.
- LA RUE, G. R. 1914b. A new cestode, *Ophiotaenia cryptobranchi* nov. sp. from *Cryptobranchus alleganiensis* (Doudin). *Reports of the Michigan Academy of Sciences* 16: 11-17.
- OSLER, 1931. A New Cestode from *Rana clamitans* Latr., *Journal of Parasitology* 17: 183-186.
- PARODI, S. E. AND WIDAKOWICH, V. 1916. Sobre una nueva especie de Taenia. *La Prensa Medica Argentina* 27: 336-339.
- PUGA, S. AND FORMAS, R. 2005. *Ophiotaenia calanensis*, a new species of proteocephalid tapeworm from the andean aquatic frog *Telmatobius dankoi* (Leptodactylidae). *Proceedings of the Biological Society of Washington* 118: 245-250.
- REGO, A. A., DOS SANTOS, J. C. & SILVA, P. P. 1974. Estudos de cestoides de peixes do Brasil. *Memorias do Instituto Oswaldo Cruz* (Rio de Janeiro) 72: 187-204.
- RIGGENBACH, E. 1896. Das genus *Ichthyotaenia*. *Revue suisse de Zoologie* 4: 165-276.
- RISER, N. W. 1942. A new Proteocephalid from *Amphiuma tridactylum* Cuvier. *Transactions of the American Microscopical Society* 4: 391-397.
- SCHMIDT, G. D. 1986. Handbook of Tapeworm Identification. *CRC Press*, Boca Raton, 675 pp.
- SHARPILO, V. P., KORNYYUCHIN, V. V. AND LISITSINA, O. I. 1979. *Batrachotaenia carpathica* sp. n. (Cestoda: Ophiotaeniidae) a new species of proteocephalid cestodes from amphibians of Europe. *Helminthologia* 16: 259-264.
- SRIVASTAV, A. K. AND CAPOOR, V. N. 1980. On a cyclophyllidean cestode, *Batrachotaenia junglesis* n. sp. from the intestines of common frog, *Rana tigrina* from suburban area of Amethi, Sultanpur. *Indian Journal of Parasitology* 3: 39.
- SZIDAT, L. AND SORIA, M. F. 1954. Cestodes y sus larvas nuevos parasitos de "*Leptodactylus ocellatus*" (L.) (Amphibia, Leptodactylidae) de la Republica Argentina. *Comunicaciones del Instituto Nacional de Investigacion de las Ciencias Naturales Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"* 2: 189-210.
- WOLFFHÜGEL, K. 1948. *Ophiotaenia noei* n. sp. (Cestodae). *Biologica* 5: 15-27.
- WOODLAND, W. N. F. 1925. On three new Proteocephalids (Cestoda) and a revision of the genera of the family. *Parasitology* 17: 370-394.
- YAMAGUTI, S. 1938. Studies on the Helminth Fauna of Japan. Part 22. Two New Species of Frog Cestodes. *Japanese Journal of Zoology* 7: 553-558.
- ZELIFF, C. C. 1932. A new species of Cestode *Crepidobothrium amphiumae* from *Amphiuma tridactylum*. *Proceedings of the United States National Museum* 81: 1-3.